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CLYPEASTER KIERI, A NEW SPECIES OF CLYPEASTEROID (ECHINODERMATA: ECHINOIDEA) FROM OFF BOMBAY, INDIA

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Abstract.—A new species of the clypeasteroid echinoid genus *Clypeaster* is described from 96–106 m depth off Bombay, India. The new species, *C. kieri,* falls within the "Stolonoclypeus" section of the genus, where it appears to have no close relatives.

Among the large collections of echinoids amassed by the International Indian Ocean Expedition and entrusted to D.L.P. for study are specimens of a new species of *Clypeaster.* The new species is described here. Type-material is deposited in the National Museum of Natural History, Smithsonian Institution (USNM).

Class Echinoidea
Family Clypeasteridae L. Agassiz, 1835
Clypeaster Lamarck, 1801
Clypeaster kieri, new species

Diagnosis.—Test with flattened margin; central part raised. Marginal internal skeleton well developed. Paired petals closed; anterior petal usually slightly open. Petaloid area 63–67% of test length. Ridges between pore-pairs of petals with 4–5 scattered tubercles.

Material examined.—HOLOTYPE (USNM E18188), International Indian Ocean Expedition, *Anton Bruun* Cruise 4B, Sta. 202A, 17°25′N, 71°39′E to 17°21′N, 71°41′E, 13 November 1963, 96–106 m, greenish sand and mud. PARATYPES: 14 specimens (USNM E18189), same locality data as holotype; 12 specimens (USNM E18190), Sta. 202B, 17°41′N, 71°33°E to 17°45′N, 71°32′E, 14 November 1963, 90 m; 5 specimens (USNM E18191), Sta. 202C, 18°27′N, 71°13′E to 18°38′N, 71°09′E, 14 November 1963, 84–97 m, coral and sand.

Etymology.—This species is named in honor of our colleague and friend Dr. Porter M. Kier, Director, National Museum of Natural History, Smithsonian Institution.

Description.—Holotype 50 mm long, 45 mm wide. Paratypes 16.1 to 55 mm long. Test longer than broad, length/width ratio ranging from 0.98 to 1.05 (see Table 1; all but one 42.8 mm long specimen longer than broad).

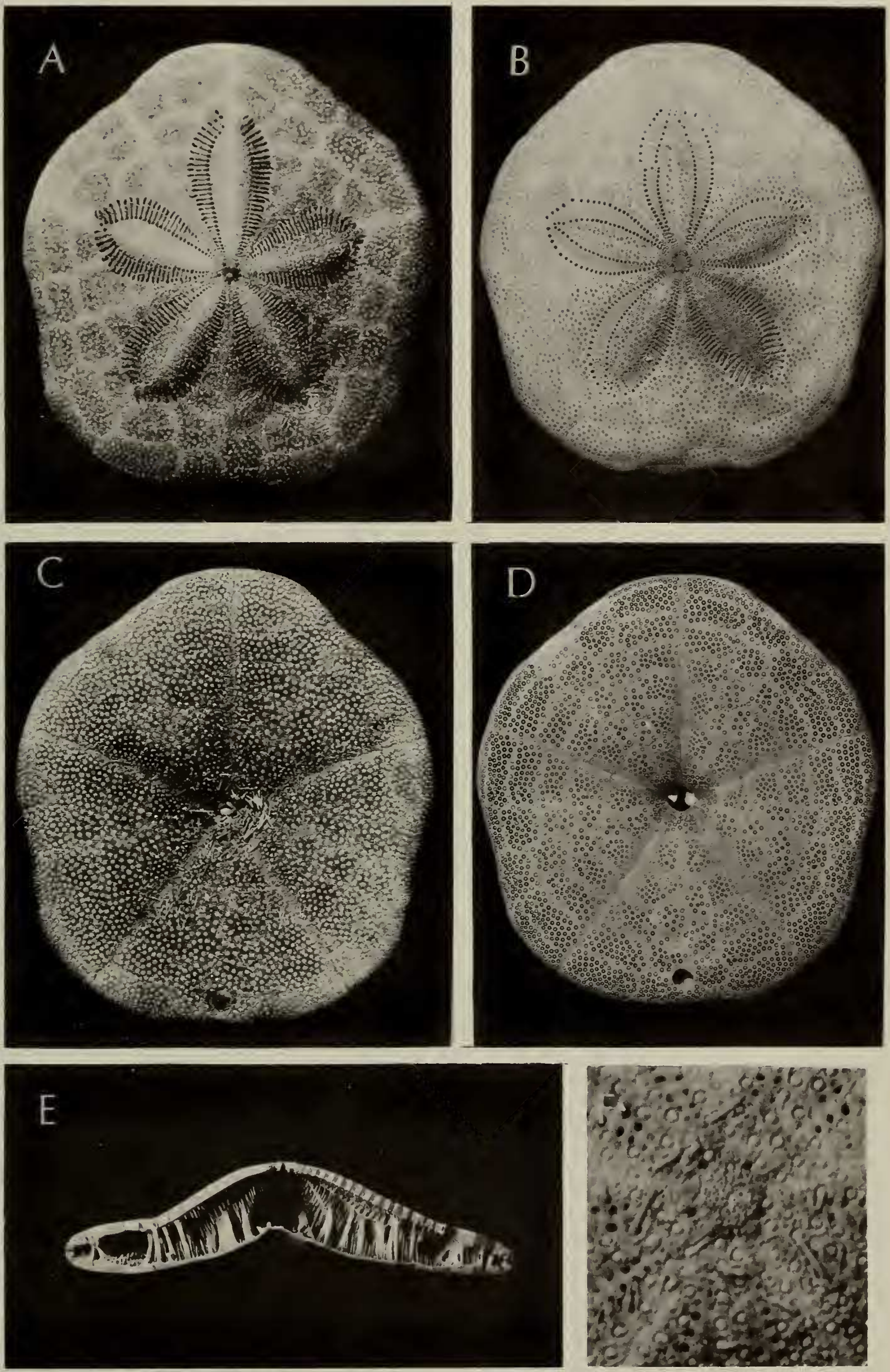

Fig. 1. *Clypeaster kieri.* **A**, Holotype, aboral view; **B**, 48 mm Paratype from Station 202A, spines removed, aboral view; **C**, Holotype, oral view; **D**, same specimen as **B**, oral view; **E**, internal structure of 53 mm Paratype from Station 202A, showing well developed marginal and central lamellae; **F**, apical system of 33 mm Paratype from Station 202C, showing well developed genital pores.

Edge of test slightly indented in each interambulacrum, except that test edge is usually convex in posterior interambulacrum. Test relatively low, more or less flat above ambitus, then gradually rising to apex. Height 22.2–27.9% of test length. Edge of test thin, approximately 7% of test length. Mouth sunken; outer edges of oral surface essentially flat. Petaloid area occupies approximately 63–67% of test length. Paired petals closed distally; anterior unpaired petal usually open, with extremities of petal edges curving towards each other. In few specimens anterior petal completely closed. Anterior petal longest, posterolateral petals next longest, anterolateral petals shortest (see Table 1). In a 19 mm long anterior petal there are 30 pairs of pores; in an anterior petal 10 mm long there are 26 pairs. On ridges between pore-pairs, number of primary tubercles increases as animals grow; in largest specimens there are 4–5 tubercles per ridge and in small specimens there are 1–3. Tubercles always scattered, never closely aggregated.

In interambulacra, primary tubercles evenly distributed; aborally there are 240–270 tubercles per cm^2. Apical system slightly posterior; distance from anterior ambitus to apex is 54–56% of test length. Five genital pores do not appear until test length of 30 mm is attained. Peristome approximately opposite apical system, circular to laterally elongate, depressed. Periproct round to slightly irregular, lying no more than its own diameter anterior to posterior edge of test.

Primary oral spines approximately 1.7 mm long, mostly cylindrical, straight to slightly curved. Primary aboral spines approximately 0.8 mm long, straight, gently tapering. Oral miliary spines straight, gently tapering, usually slightly widened at tips, 0.45–0.5 mm long; aboral miliaries similar, approximately 0.4 mm long.

Tridentate pedicellariae typical, common, larger on the oral surface (length of valves averages 0.5 mm) than on aboral surface (valves 0.31 mm). Ophicephalous pedicellariae not common, occurring apparently only near ambitus; valves approximately 0.2 mm long. No other types of pedicellariae found.

Internal skeleton consists of marginal lamellae in approximately 3 bands, forming short walls, and inner series of well developed and numerous lamellae. Two lateral water vessels lie on inner surface of each primary petal plate, each serving a respiratory tube foot and accessory tube feet. On inner surface of adoral plates lateral water vessels are unbranched, lying almost at right angles to radial water vessels. Accessory pores lie to sides of lateral water vessels, towards adapical sutures of their respective plates.

Remarks.—According to the various figures given by Mortensen (1948) and Serafy (1970, 1971), it would appear that the average size at which genital pores appear in young specimens of *Clypeaster* is approximately 35% of the maximum size attained by mature specimens. This average figure is based upon data from 16 species. As genital pores in *C. kieri* arise at a

Table 1.—Statistical data for *Clypeaster kieri.*

	Length (L)	Width (W)	Ratio L/W	Height as % of L	Petal I length/as %*	Petal II length/as %*	Petal III length/as %*
range	30.4–55	31–53.5	0.98–1.05	22.2–27.9	11.7–20.7/59.1–71.8	11.4–17.7/55.3–72.3	12.1–21.4/62.5–71.2
mean	41.6	39	1.03	24.2	15/66	13.8/65.1	15.7/68.9
S.D.	6.72	10.37	1.44	48.95	2.52/3.16	2.09/3.77	2.65/2.9

All measurements are in millimeters. * Here, petal length is expressed as a percentage of distance from apex to ambitus in corresponding interambulacrum.

test length of approximately 30 mm, it seems likely that this species attains a maximum length of approximately 85 mm.

The pattern of distribution of the water vessels and their branches conforms to that described by Phelan (1977).

This species falls within the "*Stolonoclypeus*" section of the genus, stated by Mortensen (1948) to include species which have a test with flattened margin, with oral surface flattened or concave, with petals more or less distinctly closed, and with marginal internal skeleton well developed. Within this section of the genus, *C. kieri* appears to have no very close relatives, although some features are shared with the common Indo-west-Pacific species *C. humilis* (Leske). Conspicuous differences between these 2 species are: in *C. humilis* the petaloid area occupies little more than half the test length while in *C. kieri* it occupies 63–67% of test length. In *C. humilis* the anterior unpaired petal is usually closed, while in *C. kieri* it is usually open. In *C. humilis* there are dense regular series of tubercles in the ridges between the pore-pairs in the petals; small specimens (20–50 mm?) have 3–5 tubercles and larger specimens have up to 10. In *C. kieri* these tubercles are irregularly scattered, and there are 4–5 tubercles per ridge in larger specimens. In *C. humilis* genital pores do not appear until a length of 46–50 mm is attained, while in *C. kieri* they appear at a length of approximately 30 mm.

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